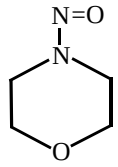
N-NITROSOMORPHOLINE

N-Nitrosomorpholine is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 59-89-2

Molecular Formula: $C_4H_8N_2O_2$



N-Nitrosomorpholine is a yellow crystalline solid. It is soluble in water and organic solvents and is sensitive to light. When heated to decomposition, it emits fumes of nitrogen oxides (NTP, 1991).

Physical Properties of N-Nitrosomorpholine

Synonyms: 4-nitrosomorpholine; NMOR

Molecular Weight:	116.11
Boiling Point:	224 - 225 °C at 747 mm Hg
Melting Point:	29 °C
Conversion Factor:	1 ppm = 4.7 mg/m^3

(HSDB, 1991; Merck, 1983; Sax, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

N-Nitrosomorpholine is used as a solvent for polyacrylonitrile and as a chemical intermediate in the production of N-aminomorpholine. Nitrosamines are also frequently produced during rubber processing and may be present as contaminants in the final rubber product (NTP, 1991). N-Nitrosomorpholine is not used commercially in the United States (U.S. EPA, 1994a).

B. Emissions

No emissions of N-nitrosomorpholine from stationary sources in California were reported, based on data obtained from the Air Toxics “Hot Spots” Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

No information about the natural occurrence of N-nitrosomorpholine was found in the readily-available literature.

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of N-nitrosomorpholine.

INDOOR SOURCES AND CONCENTRATIONS

Environmental tobacco smoke emissions of N-nitrosomorpholine were measured using six cigarette brands popular in California and one reference cigarette. N-nitrosomorpholine emissions were below the detection limit of 0.02 micrograms per cigarette (Daisey et al., 1994).

ATMOSPHERIC PERSISTENCE

By analogy with N-nitrosodimethylamine, photolysis of N-nitrosomorpholine is expected to be the dominant tropospheric loss process (Atkinson, 1995). The atmospheric lifetime of N-nitrosomorpholine is estimated to be less than one day. The reaction products are expected to be aldehydic ethers, and nitric oxide (Kao, 1994).

AB 2588 RISK ASSESSMENT INFORMATION

Since no emissions of N-nitrosomorpholine from stationary sources in California have been reported under the AB 2588 program, it was not listed in any of the risk assessments reviewed by the Office of Environmental Health Hazard Assessment.

HEALTH EFFECTS

Probable routes of human exposure to N-nitrosomorpholine are inhalation, ingestion, and dermal contact (NTP, 1994).

Non-Cancer: No information is available on the acute or chronic effects of N-nitrosomorpholine in humans. Effects on the liver from chronic exposure to N-nitrosomorpholine have been reported in animal studies. The United States Environmental Protection Agency (U.S. EPA) has not established a Reference Concentration (RfC) or an oral Reference Dose (RfD) for N-nitrosomorpholine. No information is available on adverse developmental or reproductive effects of N-nitrosomorpholine in humans or animals (U.S. EPA, 1994a).

Cancer: No information is available on the carcinogenic effects of N-nitrosomorpholine in humans. Animal studies have reported tumors of the lung, liver, kidneys, and blood vessels from oral exposure to N-nitrosomorpholine. The U.S. EPA has not classified

N-nitrosomorpholine with respect to carcinogenicity (U.S. EPA, 1994a). The International Agency for Research on Cancer has placed N-nitrosomorpholine in Group 2B: Possible human carcinogen (IARC, 1987a).

The State of California under Proposition 65 has determined that N-nitrosomorpholine is a carcinogen (CCR, 1996). The inhalation potency factor that has been used as a basis for regulatory action in California is 1.9×10^{-3} (microgram per cubic meter)$^{-1}$ (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 microgram per cubic meter of N-nitrosomorpholine is estimated to be no greater than 1,900 in 1 million. The oral potency factor that has been used as a basis for regulatory action in California is 6.7 (milligram per kilogram per day)$^{-1}$ (OEHHA, 1994).